

**NERA**

Economic Consulting



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# Economic and Environmental Impacts of EPA's 2007 Heavy-Duty Emissions Standards, Executive Summary

*for Submission to the California Energy Commission*

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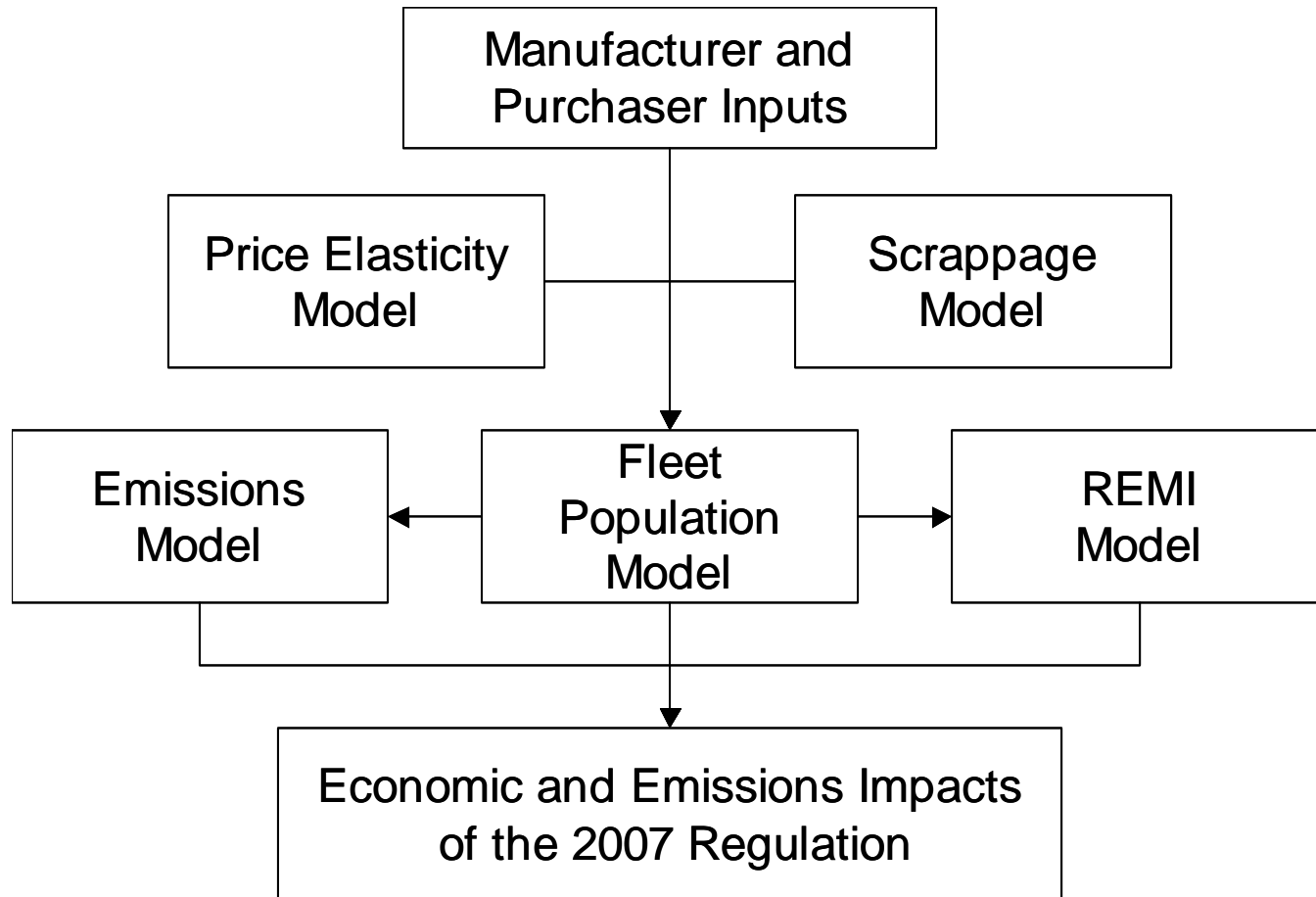
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## Overview of Study

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- This study evaluates the economic and environmental impacts of the 2007 emission standards for heavy-duty trucks
  - 2007 standards include more stringent limits for particulate matter, NO<sub>x</sub> and HC
  - Our analysis of “heavy-duty” vehicles includes heavy-heavy (Class 8) and medium-heavy trucks (Classes 6 and 7). We do not consider effects on Classes 4 and 5, although they will be affected as well
  - Study is based upon industry survey data as well as detailed models for price elasticity, fleet population effects, emissions and economic impacts
  - Study does not evaluate impacts of the 2010 emission standards
- All of the data and results in this study reflect analysis completed at the end of 2004
- Key conclusions:
  1. 2007 emission standards will increase the costs as well as the uncertainties about performance of new heavy-duty trucks in 2007
  2. Truck purchasers will respond to the increased costs and uncertainties about vehicle performance for 2007 trucks by “pre-buying” 2005 and 2006 trucks, leading to a “low-buy” effect (i.e., reduction in sales) in 2007 and 2008
  3. Increases in the prices of new trucks will lead to increases in the retention/scrappage of existing trucks
  4. These fleet population effects will substantially reduce the emissions benefits of the 2007 rule, including important benefits for federal ozone and particulate matter non-attainment areas
  5. The fleet population effects also will lead to a “boom and bust” for truck sales, and this pattern will influence overall U.S. economic activity

**Figure ES-1. Overview of NERA/AIR Modeling Framework**



## Manufacturers/Purchasers: Effects of 2007 Standard on New Heavy-Duty Truck Prices

- Manufacturer Survey of Price and Cost Impacts of 2007 Standard for Heavy-Heavy Trucks
  - Three of four major manufacturers surveyed (represent 75% of industry sales)
  - Estimates of cost/price effects include retooling (appropriately amortized), engine and equipment modification, per-vehicle variable costs as well as maintenance costs
  - Survey results include “high” and “low” estimates of +/- 20% for unit costs, +/- 30% for maintenance costs, based on the range of estimates provided by manufacturers
  - Cost estimates do not include increased fuel costs due to ultra-low sulfur diesel fuel requirements

**Table ES-1. Summary of Manufacturer Survey Results for Heavy-Heavy Trucks**

	Unit Cost	Yearly Maintenance Cost
<b>Baseline</b>	\$100,000	\$10,000
High Increase	\$7,966	\$477
Mid Increase	\$6,638	\$367
Low Increase	\$5,310	\$257

Note: Unit cost increases include engine, chassis, retooling, and labor costs. Maintenance cost increases include replacement parts, cleaning, and labor costs.

- Estimates for costs of heavy-heavy trucks were translated to impacts on medium-heavy trucks
  - No available data on medium-heavy; assume same percentage effects as heavy-heavy

**Table ES-2. Summary of Cost Increase Assumptions for Medium-Heavy Trucks**

	Unit Cost	Yearly Maintenance Cost
<b>Baseline</b>	\$60,000	\$6,000
High Increase	\$4,779	\$286
Mid Increase	\$3,983	\$220
Low Increase	\$3,186	\$154

Note: Unit cost increases include engine, chassis, retooling, and labor costs. Maintenance cost increases include replacement parts, cleaning, and labor costs.

## Manufacturers/Purchasers: Effects of 2007 Standard on “Pre-Buy” and “Low-Buy”

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- We used two basic sources of data on “pre-buy” and “low-buy” plans
  - External Industry Fleet Survey
    - Collected data from 100 heavy-heavy fleets
    - Data included responses to question on whether or not fleets are planning to pre-buy (i.e., “yes” or “no”)
  - NERA Fleet Survey
    - Objective to supplement external industry fleet survey with focused survey on likely magnitudes of pre-buy/low-buy in response to 2007 standards. Detailed data collected from eight heavy-heavy truck fleets
- Additional assumptions used to develop estimates
  - Census information (fleet mix by “straight” and “other”)
  - EPA Mobile6 (baseline sales, fleet mix by age, and VMT)
  - Medium-heavy assumed to exhibit same percentage effects as heavy-heavy
  - Baseline VMT assumed unaltered by 2007 standards
  - Purchase price increases assumed equal to manufacturing cost increases

**Table ES-3. Summary of Changes (from EPA Baseline) in Truck Sales Due to the Pre-Buy/Low-Buy Effect Only**

	2005	2006	2007	2008
Heavy-Heavy Trucks	25,324	78,753	-84,927	-19,150
Medium-Heavy Trucks	2,465	7,661	-8,263	-1,863
<b>Total (Heavy-Duty Trucks)</b>	<b>27,789</b>	<b>86,414</b>	<b>-93,190</b>	<b>-21,013</b>

## Overviews of Models Used to Develop Detailed Results

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- NERA Price Elasticity Model
  - NERA model based upon time-series regression
  - Estimated price elasticity is  $-1.9$ , i.e., a one percent increase in price is estimated to yield a 1.9 percent decrease in heavy-duty truck sales
- NERA Scrappage Model
  - Increased new vehicle prices and maintenance costs affect the behavior with respect to retention/scrappage of existing trucks
  - Higher new truck prices mean owners retain more/scrap fewer existing trucks
  - Scrappage model develops empirical estimates of these effects, including age-specific coefficients (e.g., effect of higher new truck price on four year-old trucks, five year-old trucks, etc.)
- NERA Fleet Population Model
  - Calculates population changes based upon changes due to price and pre-buy/low-buy effects, including changes in new truck sales and existing truck scrappage
  - Baseline fleet populations based upon EPA MOBILE6 model forecasts
- Emissions Model
  - AIR used the EPA MOBILE6 model to estimate effects of changes in truck populations on annual emissions
  - Assume that total vehicle miles traveled (VMT) remains the same with and without the 2007 emission standards
- Economic Impact (REMI) Model
  - State-of-the-art model of the U.S. economy
  - Includes the effects of detailed changes in the truck fleet modeled above

## Overview of Scenarios Modeled

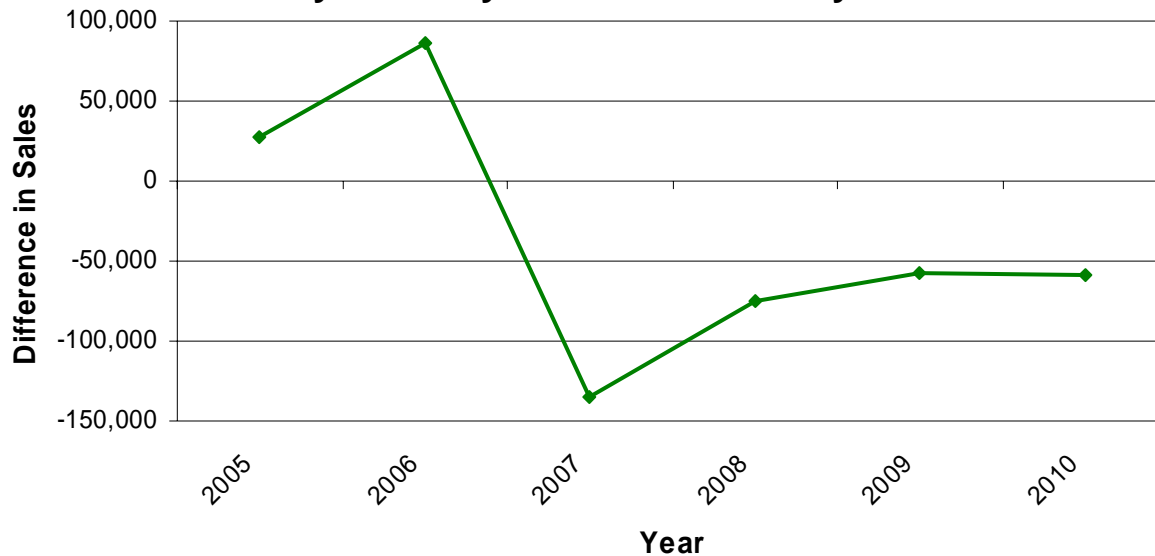
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- We evaluated three scenarios that differ on the basis of our assumptions about the magnitude of the price increase
  - The central (most likely), or Mid-Range, scenario assumes a mid-range increase in unit and maintenance costs
  - The Low-Cost Scenario assumes a low increase in unit and maintenance costs
  - The High-Cost Scenario assumes a high increase in unit and maintenance costs

## Mid-Range Results: New Heavy-Duty Truck Sales

- New truck sales go through “boom and bust” and remain lower
  - The pre-buy/low-buy effect leads to “boom and bust” scenario for truck manufacturers
  - The price elasticity effect contributes to the “bust”
  - These effects lead to combined heavy-heavy and medium-heavy sales increases of about 80,000 in 2006 and sales decreases of about 130,000 in 2007
  - The swing of 210,000 vehicles between 2006 and 2007 is roughly equivalent to EPA’s projected baseline for all Class 8 trucks (214,000 in 2007)
  - The overall U.S. economy will respond to both the initial sales “boom” and the following sales “bust”

**Figure ES-2. Changes (from EPA Baseline) in Heavy-Duty New Truck Sales, Mid-Range Scenario due to the Pre-Buy/Low-Buy and Price Elasticity Effects**



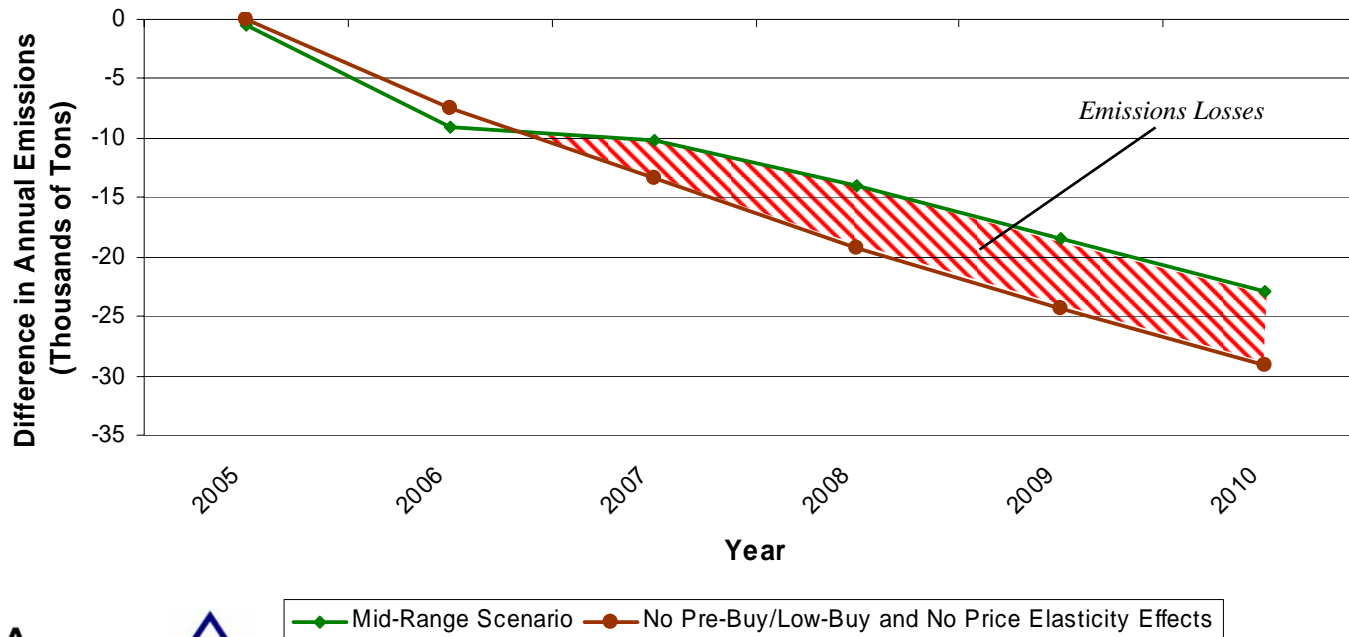
Note: Includes vehicles in Class 6 through Class 8.



## Mid-Range Results: Emissions Effects—PM<sub>2.5</sub>

- The pre-buy/low-buy and price elasticity effects diminish the effectiveness of the 2007 regulation in reducing emissions of particulate matter (PM<sub>2.5</sub>)
  - The 2007 standards still lead to declines in annual emissions, largely due to the effects of the ultra-low sulfur diesel fuel requirements
  - Even with the benefits of the fuel standards, the pre-buy/low-buy and price elasticity effects reduce annual emissions benefits by 3,000 tons (23 percent) in 2007, 5,200 tons (27 percent) in 2008, 5,900 tons (24 percent) in 2009, and 6,300 tons (22 percent) in 2010
  - Thus, the pre-buy/low-buy and price elasticity effects dramatically reduce the benefits of the 2007 technology standards
  - Between 2007 and 2010, total emissions benefits are cut by over 20,000 tons (22 percent) as a result of the price elasticity and pre-buy/low-buy effects, which could compromise the ability of federal PM non-attainment areas to reach attainment in the 2007-2010 period

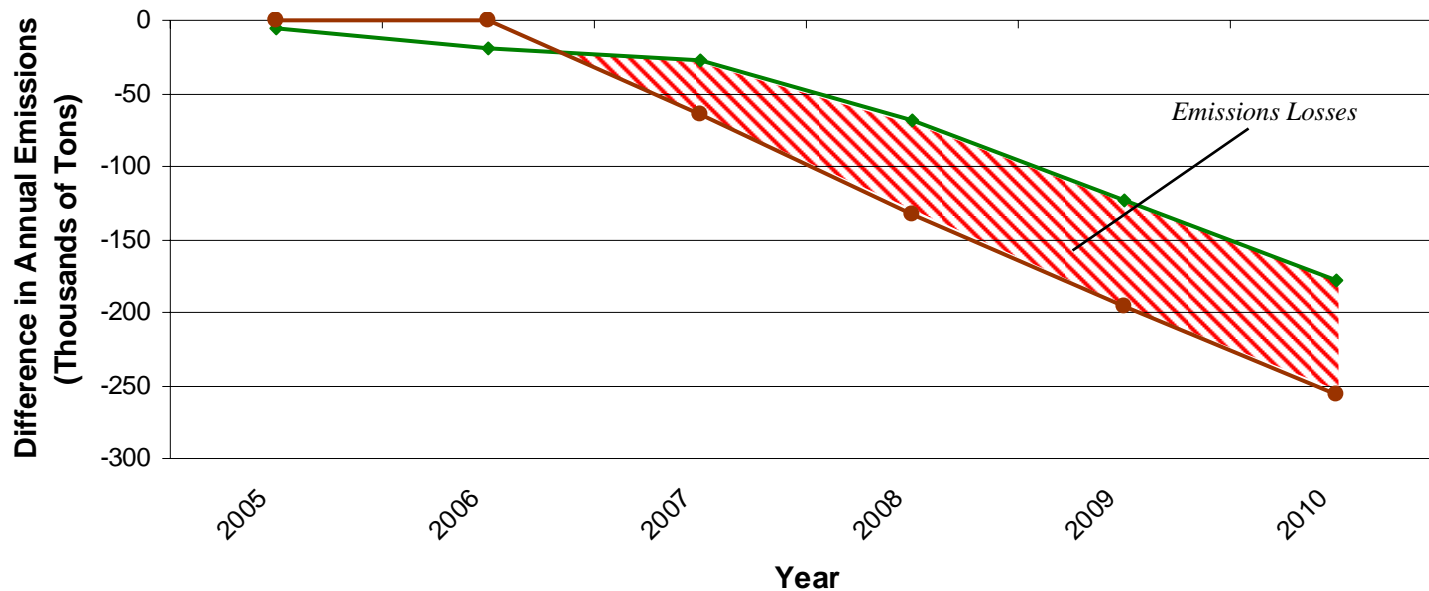
**Figure ES-3. Changes (from EPA Baseline) in Annual PM<sub>2.5</sub> Emissions, Mid-Range Scenario**



## Mid-Range Results: Emissions Effects—NO<sub>x</sub>+VOC

- The pre-buy/low-buy and price elasticity effects also diminish the effectiveness of the 2007 regulation in reducing emissions of nitrogen oxide (NO<sub>x</sub>) and volatile organic compounds (VOCs)
  - The 2007 standards still lead to declines in annual emissions
  - However, the pre-buy/low-buy and price elasticity effects reduce annual emissions benefits by 36,000 tons (58 percent) in 2007, 59,000 tons (48 percent) in 2008, 68,000 tons (37 percent) in 2009, and 73,000 tons (31 percent) in 2010
  - Between 2007 and 2010, total emissions benefits are cut by almost 240,000 tons (37 percent) as a result of the price elasticity and pre-buy/low-buy effects, which could compromise the ability of federal ozone non-attainment areas to reach attainment in the 2007-2010 period

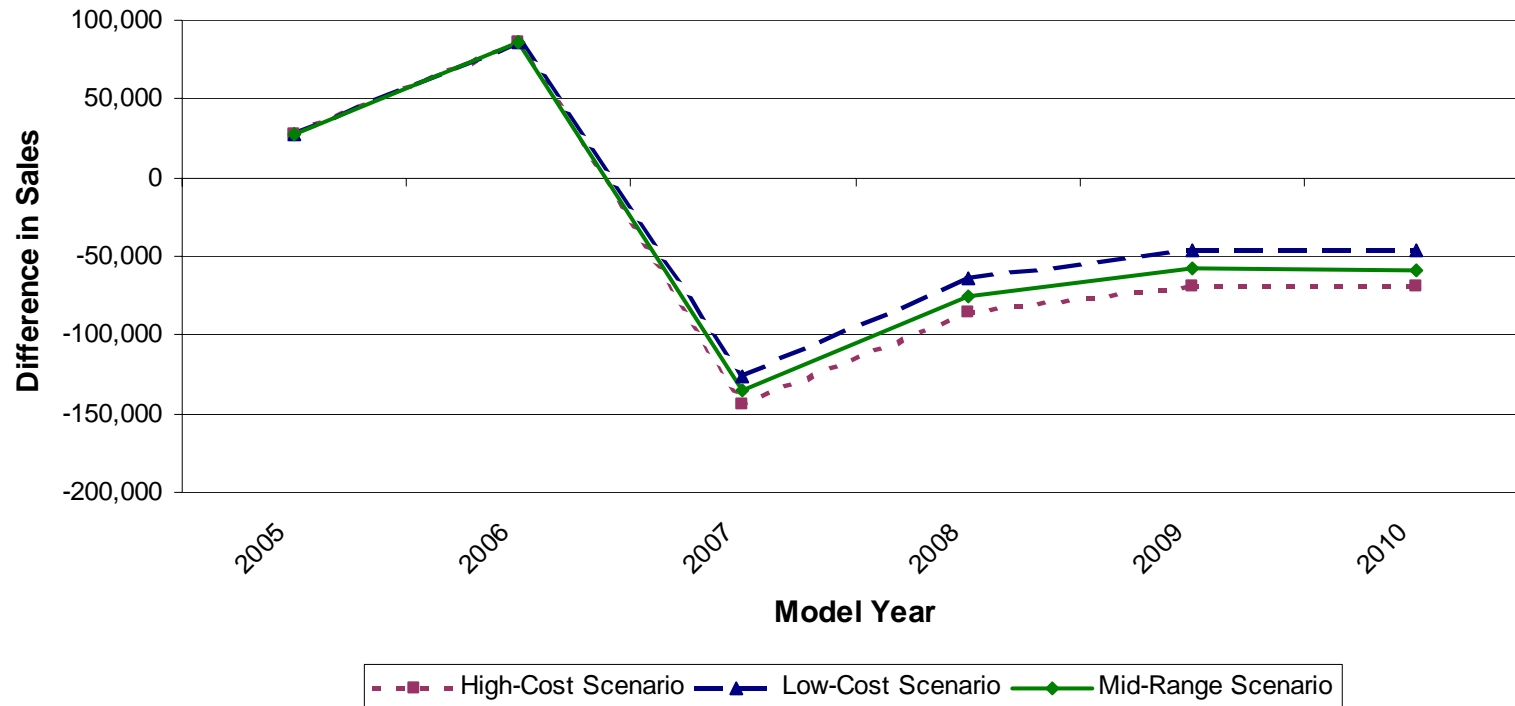
**Figure ES-4. Changes (from EPA Baseline) in Annual NO<sub>x</sub>+VOC Emissions, Mid-Range Scenario**



## Results from All Scenarios: New Truck Sales

- Alternative price/cost assumptions yield similar new truck sales impacts
  - The overall U.S. economy will respond to the “boom and bust” under alternative price/cost assumptions

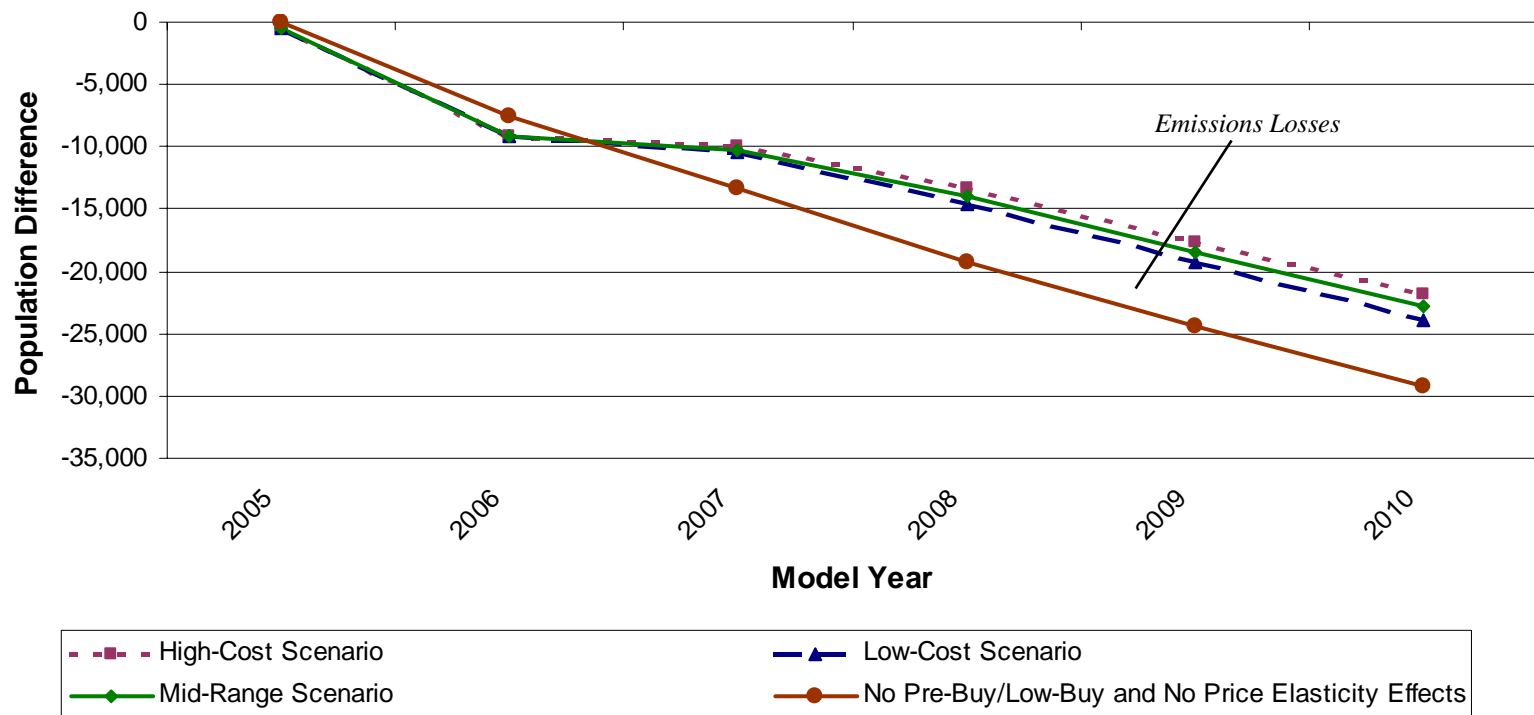
**Figure ES-5. Changes (from EPA Baseline) in Heavy-Duty Truck Sales, All Scenarios**



## Results from All Scenarios: Emissions Effects—PM<sub>2.5</sub>

- Alternative price/cost assumptions yield similar PM<sub>2.5</sub> emissions impacts

**Figure ES-6. Annual PM<sub>2.5</sub> Emissions Impacts, All Scenarios (Changes from EPA Baseline)**



## Results from All Scenarios: Emissions Effects—NO<sub>x</sub>+VOC

- Alternative price/cost assumptions yield similar NO<sub>x</sub>+VOC emissions impacts

**Figure ES-7. Annual NO<sub>x</sub>+VOC Emissions Impacts, All Scenarios (Changes from EPA Baseline)**

